Notice No.7

Rules and Regulations for the Classification of Ships, July 2021

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: June 2022

Amendments to	**Effective date**	**IACS/IMO implementation (if applicable)**
Part 3, Chapter 8, Section 5	1 July 2022	1 July 2022
Part 3, Chapter 9, Sections 3, 4 & 5	1 July 2022	N/A
Part 4, Chapter 2, Sections 10 & 11	1 July 2022	N/A
Part 4, Chapter 8, Section 17	1 July 2022	N/A

Part 3, Chapter 8
Superstructures, Deckhouses and Bulwarks

■ *Section 5*
Bulwarks, guard rails and other means for the protection of crew

5.1 General requirements

Table 8.5.1 Protection of crew

Ship ~~Type~~ type	Location in ship	Assigned Summer Freeboard, in mm	Acceptable arrangements according to type of freeboard assigned			
			Type A	Type (B-100)	Type (B-60)	Type (B & B +)
Oil tankers, chemical tankers and gas carriers (*see Pt 3, Ch 8, 1.1 Application 1.1.5*)	1.1 Access to bow 1.1.1 Between poop and bow or	≤ (A_f + H_s)	a e f(1) f(5)	a e f(1) f(5)	a e f(1) f(5)	a e f(1) f(5)
	1.1.2 Between a deckhouse containing living accommodation or navigation equipment, or both, and bow, or 1.1.3 In the case of a flush deck vessel, between crew accommodation and the forward ends of ship	> (A_f + H_s)	a e f(1) ~~f(5)~~f(2)			
	1.2 Access to after end In the case of a flush deck vessel, between crew accommodation and the after end of ship	As required in item 2.2.4 in ~~*Pt 3, Ch 8, 5.3 Freeing arrangements 5.3.7*~~*Table 8.5.1 Protection of crew* for other types of ships				
Other ship type	2.1 Access to midship quarters 2.1.1 Between poop and bridge, or	≤ 3000 mm	a b e	a b e	a b c(1) e f(1)	a b c(1) c(2) c(4) d(1) d(2) d(3) e f(1) f(2) f(4)
	2.1.2 Between poop and deckhouse containing living accommodation or navigation equipment, or both	> 3000 mm	a b e	a b e	a b c(1) c(2) e f(1) f(2)	
	2.2 Access to ends 2.2.1 Between poop and bow (if there is no bridge), 2.2.2 Between bridge and bow, or	≤ 3000 mm	a b c(1) e f(1)	a b c(1) c(2) e f(1) f(2)	a b c(1) c(2) e f(1) f(2)	
	2.2.3 Between a deckhouse containing living accommodation or navigation equipment, or both, and bow, or 2.2.4 In the case of a flush deck vessel, between crew accommodation and the forward and after ends of ship	> 3000 mm	a b c(1) d(1) e f(1)	a b c(1) c(2) d(1) d(2) e f(1) f(2)	a b c(1) c(2) c(4) d(1) d(2) d(3) e f(1) f(2) f(4)	

Symbols

A_f = the minimum summer freeboard calculated as Type A ship regardless of the type of freeboard actually assigned
H_s = the standard height of superstructure as defined in *International Convention on Load Lines*, Regulation 33

Acceptable arrangements:
Acceptable arrangements referred to in the Table are defined as follows:

a: A well-lighted and ventilated ~~under-deck~~ underdeck passageway (clear opening 0,8 m wide, 2 m high) as close as practicable to the freeboard deck, connecting and providing access to the locations in question.

b: A permanent and efficiently constructed gangway fitted at or above the level of the superstructure deck on or as near as practicable to the centreline of the ship, providing a continuous platform at least 0,6 m in width and a non-slip surface, with guard rails extending on each side throughout its length. ~~Guard-rails~~ Guard rails shall be at least 1 m high with courses as required in *Pt 3, Ch 8, 5.1 General requirements*, ~~and supported by stanchions spaced not more than 1,5 m;~~ and a foot-stop shall be provided.
c: A permanent walkway at least 0,6 m in width fitted at freeboard deck level consisting of two rows of ~~guard-rails~~ guard rails with stanchions spaced not more than 3 m. The number of courses of rails and their spacing are to be as required by *Pt 3, Ch 8, 5.1 General requirements*. On Type B ships, hatchway coamings not less than 0,6 m in height may be regarded as forming one side of the walkway, provided that between the hatchways two rows of guard rails are fitted.
d: A ~~10 mm minimum thickness diameter~~ wire rope life-line not less than 10 mm in diameter, supported by stanchions ~~about~~ not more than 10 m apart, or a single ~~hand-rail~~ hand rail or wire rope attached to hatch coamings, continued and adequately supported between hatchways.
e: A permanent and efficiently constructed gangway fitted at or above the level of the superstructure deck on or as near as practicable to the centreline of the ship: • located so as not to hinder easy access across the working areas of the deck; • providing a continuous platform at least 1,0 m in width (may be reduced to 0,6 m for tankers less than 100 m in length); • constructed of fire-resistant and non-slip material; • fitted with guard rails extending on each side throughout its length; guard rails should be at least 1,0 m high with courses as required by Regulation 25(3) and supported by stanchions spaced not more than 1,5 m; • provided with a foot stop on each side; • having openings, with ladders where appropriate, to and from the deck. Openings should not be more than 40 m apart; • having shelters of substantial construction set in way of the gangway at intervals not exceeding 45 m if the length of the exposed deck to be traversed exceeds 70 m. Every such shelter should be capable of accommodating at least one person and be so constructed as to afford weather protection on the forward port and starboard sides.
f: A permanent and efficiently constructed walkway fitted at freeboard deck level on or as near as practicable to the ~~centre line~~ centreline of the ship having the same specifications as those for a permanent gangway listed in ~~(e)~~ except for foot-stops. On Type B ships (certified for the carriage of liquids in bulk)~~,~~ with a combined height of hatch coaming and fitted hatch cover of together not less than 1 m in height, the hatchway coamings may be regarded as forming one side of the walkway, provided that between the hatchways two rows of guard rails are fitted.
Alternative transverse locations for c, d and f: (1) At or near centreline of ship; or fitted on hatchways at or near centreline of ship. (2) Fitted on each side of the ship. (3) Fitted on one side of the ship, provision being made for fitting on either side. (4) Fitted on one side of the ship only. (5) Fitted on each side of hatchways as near to the centreline as practicable.
NOTES **Note** *1.* In all cases where wire ropes are fitted, adequate devices (for example turnbuckles) are to be provided to ensure their tautness.
Note *2.* Wire ropes may only be accepted in lieu of guard rails in special circumstances and then only in limited lengths.
Note *3.* Lengths of chain may only be accepted in lieu of guard rails if fitted between two fixed stanchions.
Note *4.* Where stanchions are fitted, every third stanchion is to be supported by a bracket or stay.
Note *5.* Removable or hinged stanchions shall be capable of being locked in the upright position.
Note *6.* A means of passage over obstructions, if any, such as pipes or other fittings of a permanent nature, should be provided.
Note *7.* Generally, the width of the gangway or deck-level walkway should not exceed 1,5 m.

■ *Section 3* Decks loaded by wheeled vehicles

3.5 Deck longitudinals and beams

Table 9.3.4 Secondary stiffener requirements

Scantling requirement	Load case	
	$d \leq l$	$d > l$
Section modulus Z, in cm^3	$Z = \left(\frac{k_{\cancel{w}w} F_{\cancel{tys}tys}(3l^2 - d^2)}{f_{bdg} l} + \frac{\cancel{p}P_{tyw} s l^2}{10}\right)\frac{10^3}{f_\sigma \sigma_o}$	$\cancel{z}Z = \left(\frac{k_{\cancel{w}w} F_{tys} l^2}{10d} + \frac{\cancel{p}P_{tyw} s l^2}{10}\right)\frac{10^3}{f_\sigma \sigma_o}$
Inertia, I, in cm^4	$I = \left(\frac{k_{\cancel{w}w} F_{\cancel{tys}tys}(2l^{\cancel{2}3} - 2d^2 l + d^3)}{f_{bdg} l} + \frac{\cancel{p}P_{tyw} s l^{\cancel{2}3}}{288}\right)\frac{10^5}{f_\delta E}$	$I = \left(\frac{k_{\cancel{w}w} F_{tys} l^3}{f_{bdg} d} + \frac{\cancel{p}P_{tyw} s l^{\cancel{2}3}}{288}\right)\frac{10^5}{f_\delta E}$
Web area, A_w, in cm^2	$A_w = \left(\frac{k_{\cancel{w}w} F_{\cancel{tys}tys}(m^3 - 2m^2 + 2)}{f_{bdg}} + \frac{\cancel{p}P_{tyw} s l}{2}\right)\frac{10}{f_\tau \tau_o}$ where $\boldsymbol{m = d/l}$	$A_w = \left(\frac{k_{\cancel{w}w} F_{tys} l}{2d} + \frac{\cancel{p}P_{tyw} s l}{2}\right)\frac{10}{f_\tau \tau_o}$

Symbols	
l	= overall secondary stiffener length, in metres
s	= stiffener spacing, in metres
d	= dimension of load area parallel to stiffener axis, in metres
E	= Young's Modulus of steel, to be taken as ~~20600~~ 206000 N/mm^2
w	= dimension of load area perpendicular to stiffener axis, in metres
k_w	= lateral loading factor
	= 1 for $w \leq s$
	= s/w for $w > s$
F_{tys}	= point load given in *Table 9.3.7 Design load cases*, in kN
P_{tyw}	= design deck load given in *Table 9.3.7 Design load cases*, in kN/m^2
f_σ, f_δ, f_τ	= structural design factors given in *Table 9.3.6 Structural design factors ~~(normal stress)~~*
f_{bdg}	= bending moment factor given in *Table 9.3.5 Bending moment factor*
$\cancel{\sigma o}$ σ_o	= specified minimum yield strength of the material, in N/mm^2
$\cancel{\tau o}$ τ_o	= shear strength of the material, in N/mm^2
	$= \frac{\sigma_o}{\sqrt{3}}$

Table 9.3.6 Structural design factors ~~(normal stress)~~

Scenario	~~Structural design factor~~ f_σ	f_τ	f_δ
1. Loading by fork lift trucks on general purpose cargo decks	1,5	1,5	0,001
2. Loading by wheeled vehicles and other deck cargo	0,75	0,75	
3. Loading by wheeled vehicles only	0,75	0,75	
4. Loading by wheeled vehicles only on longitudinally effective structure	0,525	0,525	
Note Structural design factors for ~~shear and~~ equivalent stress are to be derived as appropriate.			

■ *Section 4*
Movable decks

4.6 Pontoon webs and stiffeners

Existing paragraphs 4.6.1, 4.6.2 and Table 9.4.1 have been deleted and replaced with the following.

4.6.1 The minimum section modulus of webs and stiffening of steel pontoon secondary stiffeners is to be calculated in accordance with *Pt 3, Ch 9, 3 Decks loaded by wheeled vehicles, Table 9.3.4 Secondary stiffener requirements* using the Scenario 1 structural design factor given in *Pt 3, Ch 9, 3 Decks loaded by wheeled vehicles, Table 9.3.6 Structural design factors* and the Scenario 1 loads defined in *Pt 3, Ch 9, 3 Decks loaded by wheeled vehicles, Table 9.3.7 Design load cases*.

4.6.2 The section modulus of webs and stiffening of aluminium pontoons is to be not less than that defined in *Pt 3, Ch 9, 4.6 Pontoon webs and stiffeners 4.6.1*, replacing σ_o by σ_a, where σ_a is defined in *Pt 3, Ch 2, 1.3 Aluminium*.

■ *Section 5*
Helicopter landing areas

5.4 Landing area plating

(Part only shown)
5.4.1 The deck plate thickness, t, within the landing area is to be not less than:

$t = t_1 + 1{,}5$ mm

where

t_1 = $\frac{\alpha s}{1000\sqrt{k}}$ mm
α = thickness coefficient obtained from *Figure 9.3.1 Tyre print chart*
β = tyre print coefficient used in *Figure 9.3.1 Tyre print chart*
$\cancel{= log_{10}\left(\frac{P_1 k2}{s2} \times 10_7\right)}$
$= log_{10}\left(\frac{P_1 k^2}{s^2} \times 10^7\right)$
s = stiffener spacing, in mm
k = material factor as defined in *Pt 3, Ch 9, 1.2 Symbols* for steel members

For wheeled undercarriages, the tyre print dimensions specified by the manufacturer are to be used for the calculation. Where these are unknown, it may be assumed that the print area is 300 x 300 mm and this assumption is to be indicated on the submitted plan. For the tyre print area of a group of wheels, *see Pt 3, Ch 9, 3.5 Deck longitudinals and beams 3.5.3.*

(Part only shown)
5.4.2 The plate thickness for aluminium alloy decks is to be not less than:

$t = 1{,}4t_1 + \cancel{1{,}5}0{,}5$ mm

5.5 Deck stiffening and supporting structure

5.5.1 The helicopter deck stiffening and the supporting structure for helicopter platforms are to be designed for the load cases given in *Table 9.5.2 Design load cases for deck stiffening and supporting structure* ~~in association with the permissible stresses given in *Table 9.5.3 Permissible stresses for deck stiffening and supporting structure*~~. The helicopter is to be positioned so as to produce the most severe loading condition for each structural member under consideration.

5.5.2 The minimum requirements for secondary stiffeners are to be in accordance with the requirements of *Pt 3, Ch 9, 3 Decks loaded by wheeled vehicles, Table 9.3.4 Secondary stiffener requirements* using the *UDL* and helicopter patch loads given in *Table 9.5.2 Design load cases for deck stiffening and supporting structure*. The structural design factors, f_σ and f_τ, are to be taken as the permissible bending and shear stresses given in *Table 9.5.3 Permissible stresses for deck stiffening and supporting structure* divided by the specified minimum yield and shear strengths of the material respectively.

~~5.5.2~~ 5.5.3 The minimum moment of inertia, I, of aluminium alloy secondary structure stiffening is to be not less than:

$I = \frac{5.25}{k_{\cancel{aa}}} Z l_{\cancel{ee}}$ ~~cm4~~cm^4

where Z is the required section modulus of the aluminium alloy stiffener and attached plating and k_a as defined in *Pt 3, Ch 2, 1.3 Aluminium*.

5.5.4 When the deck is constructed of extruded aluminium alloy sections, the scantlings and connections between structural members will be specially considered.

~~5.5.3~~ 5.5.5 Where a grillage arrangement is adopted for the platform stiffening, and for the truss structures supporting a helicopter landing area, it is recommended that direct calculation procedures be used in association with the permissible stresses given in *Table 9.5.3 Permissible stresses for deck stiffening and supporting structure*.

5.5.6 Where the helicopter landing area is supported by truss structures, the deck in way of the bottom of the truss structures is to be assessed for the loads imposed by the helideck, in accordance with *Table 9.5.3 Permissible stresses for deck stiffening and supporting structure*.

Table 9.5.2 Design load cases for deck stiffening and supporting structure

~~Loadcase~~ Load case	Loads			
	Landing area		Supporting structure (*see* Note 1)	
	UDL, in kN/m^2	Helicopter patch load (*see* Notes 2 and 3)	Self-weight	Horizontal load (*see* Notes 2 and 4)
(1) Overall distributed loading	2	—	—	—
(2) Helicopter emergency landing	0,5	$2{,}5P_w f$	W_h	$0{,}5P_h$
(3) Normal ~~usage~~ landing	0,5	$1{,}5P_w$	W_h	$0{,}5P_h + 0{,}5W_h$

Symbols

P_h and P_w as defined in *Pt 3, Ch 9, 5.4 Landing area plating 5.4.1*

UDL = Uniformly distributed vertical load over entire landing area

W_h = structural self-weight of helicopter platform

Note *1.* For the design of the supporting structure for helicopter platforms, applicable self-weight and horizontal loads are to be added to the landing area loads.

Note *2.* The helicopter is to be so positioned as to produce the most severe loading condition for each structural member under consideration.

Note *3.* For the emergency landing and normal usage load cases, the helicopter patch load is to be increased by a suitable structural response factor depending upon the natural frequency of the helideck structure. This factor is to be taken as 1,3 unless calculations are submitted justifying a lower factor. In cases where the **Occasional Helicopter Landing Area** notation is to be assigned, this factor can be taken as 1,0. For helidecks constructed of aluminium alloys, the value of the structural response factor is to be specially considered.

Note *4.* For the design of stiffening and truss support structures supporting a helicopter landing area, appropriate wind loads shall be considered for all load cases in accordance with *Pt 3, Ch 9, 9.2 Loading*, where the wind speed is to be taken as 31 m/s. The wind direction, together with the horizontal imposed load (if applicable), is to produce the most severe loading condition for each structural component considered.

Table 9.5.3 Permissible stresses for deck stiffening and supporting structure

	Permissible stresses, in N/mm^2 (*see* Notes 1 and 2)			
~~Loadcase~~ Load case ~~(~~(*See* *Table 9.5.2 Design load cases for deck stiffening and supporting structure*)	Deck secondary structure (beams, longitudinals) (*see* Note~~s~~ 3~~1 and 2~~)	Primary structure (transverses, girders, pillars, trusses)		All structure
	Bending		Combined bending and axial	Shear
(1) Overall distributed load	$\cancel{\frac{147}{k}}\frac{141}{k}$	$\cancel{\frac{147}{k}}\frac{141}{k}$	$0{,}6\cancel{\sigma}\sigma_c$	$\frac{\text{Bending}}{\sqrt{3}}$
(2) Helicopter emergency landing	$\cancel{\frac{245}{k}}\frac{235}{k}$	$\cancel{\frac{220{,}5}{k}}\frac{211{,}5}{k}$	$0{,}9\cancel{\sigma}\sigma_c$	
(3) Normal ~~usage~~ landing	$\frac{176}{k}$	$\cancel{\frac{147}{k}}\frac{153}{k}$	$0{,}65\cancel{\sigma}\sigma_c$	

Symbols

k = a material factor:

= as defined in *Pt 3, Ch 9, 1.2 Symbols* for steel members

= k_a as defined in *Pt 3, Ch 9, 4.6 Pontoon webs and stiffeners 4.6.2* for aluminium alloy members

σ_c = yield stress, 0,2% proof stress or critical ~~compressive~~ buckling stress, in N/mm^2, whichever is the lesser

Note *1.* For strength deck longitudinals and girders, the permissible bending stresses are to be reduced as follows:

Note *(a)* within 0,4*L* of amidships - by 30% **Note** *(b)* at the F.P. or A.P. - by 0% Values at intermediate locations are to be determined by interpolation between (a) and (b). **Note** *2*. For helicopter landing areas on offshore support vessels, the permissible bending stresses are to be reduced by 20%. **Note** ~~*2*~~*3*. When determining bending stresses in secondary structure, for compliance with the above permissible stresses, 100% end fixity may be assumed.

Part 4, Chapter 2
Ferries, Roll On-Roll Off Ships and Passenger Ships

■ *Section 10*
Miscellaneous openings

10.4 Frame design and testing

10.4.1 **Application**. The testing requirements contained in this Section are for all exterior window ~~and glass balustrade~~ designs on all tiers for passenger ships regardless of length. The testing is to be carried out for characteristic window ~~and balustrade~~ sizes (largest, smallest) and forms (circular, semicircular and rectangular) for each passenger ship. Window ~~and balustrade~~ designs~~,~~ which are not covered by Type Approval Certification~~,~~ will require prototype testing in order to confirm structural integrity and weather or water tightness as required. Tests are to be carried out to the satisfaction of the Surveyor.

10.4.3 **Structural testing**. A hydrostatic test is to be carried out in order to examine the capability of the frame, mullions and the retaining arrangement for the glazing. This is carried out by applying a test pressure of $4H_d$ (H_d as calculated in *Pt 4, Ch 2, 10.3 Strength assessment of windows in large passenger ships* for windows ~~and~~ ~~*Pt 4, Ch 2, 11.3 Weather design loads for balustrades*~~) to the external face of the window, utilising an aluminium alloy plate of appropriate temper and thickness to simulate the flexural response in lieu of the glazing. A full-scale test with actual glazing in place may be acceptable provided that the stresses induced are within allowable limits. Details of the calculations made and testing procedures are to be submitted for review prior to the test. Alternative means of demonstrating adequacy of the frame, mullions and the retaining arrangement for the glazing may be specially considered.

■ *Section 11*
External glass balustrades

Existing Section 11 has been deleted and replaced by the following.

11.1 General

11.1.1 Attention is drawn to relevant requirements of National and International Standards concerning the construction of barriers using glass, as well as applicable Statutory Regulations for the Protection of Crew, *see Load Lines, 1966/1988 - International Convention on Load Lines, 1966*, as Amended by the Protocol of 1988 and its Protocol of 1988.

11.1.2 The requirements of this Section apply solely to external glass balustrades. External glass balustrades are barriers constructed with glass that are used on exposed decks.

11.1.3 External glass balustrades are not to be situated in areas deemed essential for the operation of the ship. Such areas include but are not limited to mooring decks, lifeboat decks, external muster stations and in the vicinity of davits. Where external glass balustrades are not to be used, more traditional bulwarks or guard rails are to be fitted in accordance with *Pt 3, Ch 8, 5 Bulwarks, guard rails and other means for the protection of crew.*

11.1.4 Glass is to be manufactured in accordance with a recognised National or International Standard.

11.2 Design considerations

11.2.1 External glass balustrades are to be designed to resist the most unfavourable anticipated loads within service, including weather loads or personnel loads, without unacceptable deflection. Detailed plans and calculations are to be submitted clearly indicating the position, arrangement and the anticipated loads for all external glass balustrades.

11.2.2 Laminated toughened glass is to be used for the glazing of all external glass balustrades. The use of chemically strengthened glass is generally limited to passenger yachts but will be considered on a case-by-case basis on other ship types.

11.2.3 The minimum characteristic breaking strength of the glass corresponding to a 90 per cent confidence level is to be as required by *Table 2.11.1 Characteristic breaking strength of glass*.

Table 2.11.1 Characteristic breaking strength of glass

Glass type	Characteristic breaking strength N/mm^2
Thermally strengthened glass	120
Chemically strengthened glass	160

11.2.4 External glass balustrades are to be not less than 1,0 m in height.

11.2.5 External glass balustrades are to provide water freeing areas in accordance with *Pt 3, Ch 8, 5.3 Freeing arrangements*.

11.2.6 In general, openings (e.g. the gaps between panels or the gap between the deck and the bottom of a panel) should not be greater than 76 mm unless required for water freeing. Openings for water freeing are not to be greater than 230 mm.

11.2.7 Consideration is to be given to minimising the possibility of surface deterioration of the balustrade glass panels in service by means of suitable edge protection or finishes.

11.2.8 For thermally strengthened glass, *see also Pt 4, Ch 2, 11.9 Testing 11.9.3*.

11.3 Types of glass balustrade

11.3.1 The following types of glass balustrade are acceptable:

- free-standing glass balustrade;
- free-standing glass balustrade with top rail;
- barrier with infill panel.

11.3.2 A free-standing glass balustrade is clamped at the bottom of the glass panel, *see Pt 4, Ch 2, 11.8 Connections*, and free to rotate at the top.

11.3.3 A free-standing glass balustrade with a handrail is clamped at the bottom of the glass panel, *see Pt 4, Ch 2, 11.8 Connections*, and free to rotate at the top. The handrail is to be designed such that it spans between panels of glass within the balustrade so that in the event of the failure of one panel, the handrail will remain attached.

11.3.4 A barrier with an infill panel is a steel or aluminium framed structure with a glass infill panel which is supported either with a continuous edge or by isolated bolt fixings or clamps, *see Pt 4, Ch 2, 11.8 Connections*.

11.4 Loads

11.4.1 The weather load, P_{gb}, in kN/m^2, is given by:

$$\boldsymbol{P_{gb} = 9{,}81H_d}$$

where H_d is as required by *Table 2.10.2 Design pressure, H_d, on windows*. For passenger yachts, the weather loads can be determined in accordance with the requirements of *Pt 4, Ch 2, 10.4 Loads 10.4.1* of the *Rules and Regulations for the Classification of Special Service Craft*.

11.4.2 The horizontal pressure (applied perpendicular to the balustrade) due to personnel loads is to be taken as 1,5 kN/m for unpopulated areas (e.g. balconies) and 2,25 kN/m for populated areas (e.g. areas where people could congregate). The load is to be applied to the top of the balustrade.

11.4.3 A safety factor of 4,0 is to be applied to the personnel load.

11.4.4 A safety factor of 2,0 is to be applied to the weather load.

11.4.5 When calculating the applied bending moment, M_g, free-standing glass balustrades are to be considered as cantilever beams of unit width and infill panels are to be considered as simply supported beams of unit width.

11.4.6 The loads are to be considered as separate load cases.

11.5 Glass thickness

11.5.1 The required thickness of monolithic glass, t_{req}, is given by:

$$t_{\mathrm{req}} = \sqrt{\frac{6Z_{\mathrm{req}}}{1000}}\,\mathrm{mm}$$

where

Z_{req} is the required section modulus of the glass panel, in mm^3

$$Z_{\mathrm{req}} = \frac{M_{\mathrm{g}} \times 10^6}{\sigma}$$

M_g is the applied bending moment for the considered load case, in kNm, *see Pt 4, Ch 2, 11.4 Loads 11.4.5*

σ is the characteristic breaking strength of the glass, in N/mm^2, *see Pt 4, Ch 2, 11.2 Design considerations 11.2.3*

11.5.2 The effective thickness of laminated glass, t_d, in mm, for deflection is given by:

$$t_{\mathrm{d}} = \sqrt[3]{(t_1^3 + t_2^3 + \cdots + t_{\mathrm{n}}^3) + 12\omega(t_1 d_1^2 + t_2 d_2^2 + \cdots + t_{\mathrm{n}} d_n^2)}\ \mathrm{mm}$$

where

t_1, t_2, t_n = thickness of each ply, in mm

d_1, d_2, d_n = distance between the middle of each ply and the middle of the laminated glass pane, in mm

ω = shear transfer coefficient of the interlayer, *see Table 2.11.2 Shear transfer coefficient*

11.5.3 The effective thickness of laminated glass, t_s, in mm, for bending is given by:

$$t_s = \sqrt{\frac{t_d^3}{t_{max} + 2\omega d_{max}}}$$

where

t_d = effective thickness of laminated glass for deflection, in mm, *see* *Pt 4, Ch 2, 11.5 Glass thickness 11.5.2*

t_{max} = thickness of thickest ply, in mm

d_{max} = distance between the middle of the thickest ply and the middle of the laminated glass pane, in mm

ω = shear transfer coefficient of the interlayer, *see* *Table 2.11.2 Shear transfer coefficient*

11.5.4 The shear transfer coefficient is dependent on the interlayer, where a shear transfer coefficient of 1 indicates that all the load is transferred between the plies. Common shear transfer coefficients are given in *Table 2.11.2 Shear transfer coefficient*; where an alternative interlayer is specified, the shear transfer coefficient can be obtained by means of a four-point bending test in accordance with EN-ISO 1288-3 or an equivalent recognised National or International Standard.

Table 2.11.2 Shear transfer coefficient

Load type	Family 1 (e.g. PVB)	Family 2 (e.g. Ionoplast)
Weather	0,3	0,7
Personnel - normal	0,1	0,5
Personnel - crowds	0	0,3
Note Refer to EN 16613 *Glass in building – Laminated glass and laminated safety glass – Determination of interlayer viscoelastic properties*		

11.6 Assessment

11.6.1 The effective thickness of a laminated glass panel, *see* *Pt 4, Ch 2, 11.5 Glass thickness 11.5.2* and *Pt 4, Ch 2, 11.5 Glass thickness 11.5.3*, is to be greater than or equal to the required thickness of a monolithic glass panel, *see* *Pt 4, Ch 2, 11.5 Glass thickness 11.5.1*. Alternatively, the strength of the glass balustrade can be assessed using Finite Element Analysis where the loads and safety factor are to be as required by *Pt 4, Ch 2, 11.4 Loads* in association with the glass strength given in *Pt 4, Ch 2, 11.2 Design considerations 11.2.3* and the shear transfer coefficient given in *Pt 4, Ch 2, 11.5 Glass thickness 11.5.4.*

11.6.2 For free-standing glass balustrades, a post-failure check is to be carried out in accordance with *Pt 4, Ch 2, 11.9 Testing 11.9.2*.

11.7 Balustrade stanchions and top rail

11.7.1 Where fitted, balustrade stanchions are to have adequate strength to resist the anticipated loads specified in *Pt 4, Ch 2, 11.4 Loads*.

11.7.2 Where fitted, the top rail is to be sufficiently stiff so as not to deflect more than $L_b/96$ when subject to the personnel loads specified in *Pt 4, Ch 2, 11.4 Loads*, where L_b is the span of the top rail between stanchions.

11.7.3 The top rail minimum section modulus is to be greater than:

$$\boldsymbol{Z} = \frac{\mathbf{141}\boldsymbol{q}_{\mathbf{k}}\boldsymbol{L}_{\mathbf{b}}^{\mathbf{2}}}{\boldsymbol{f}_{\boldsymbol{\sigma}}\boldsymbol{\sigma}_{\mathbf{o}}} \quad \text{cm}^3$$

where

q_k = line load on top rail, in kN/m, determined based on the personnel loads and associated safety factor given in *Pt 4, Ch 2, 11.4 Loads*

L_b = the span of the top rail between stanchions, in m

f_σ = bending stress coefficient, not to be taken as less than 0,6

σ_o = specified minimum yield stress, in N/mm^2

11.8 Connections

11.8.1 The connections of external glass balustrades are to be designed in accordance with a recognised National or International Standard in association with the loads given in *Pt 4, Ch 2, 11.4 Loads*. Typical examples of connection design are given in *Table 2.11.3 Typical glass balustrade connections*.

11.8.2 Where sealant is used in association with a clamping system, the minimum depth of the clamp is to be 100 mm for free-standing glass balustrades and 50 mm for infill panels (i.e. 50 mm for each clamp top and bottom).

11.8.3 The strength of connection designs is to be verified using a prototype strength test, *see Pt 4, Ch 2, 11.9 Testing 11.9.4*. Where a designer proposes to change a design including, but not limited to, a change in clamp size, bolt size, sealant type, overlaps, clearance and manufacturer, the prototype test is to be repeated. Where testing is impractical or where the proposed connection design is unusual, Finite Element Analysis is to be used to confirm the strength of the connection.

Table 2.11.3 Typical glass balustrade connections

Type of glass balustrade	Connection type	
Infill panel	Bolt fixing	*see Figure 2.11.1 Bolt fixing*
	Clamp fixing	*see Figure 2.11.2 Clamp fixing*
Free-standing	Continuous fixing clamp	*see Figure 2.11.3 Continuous fixing clamp*
	Alternative clamping system	*see Figure 2.11.4 Alternative clamping system*

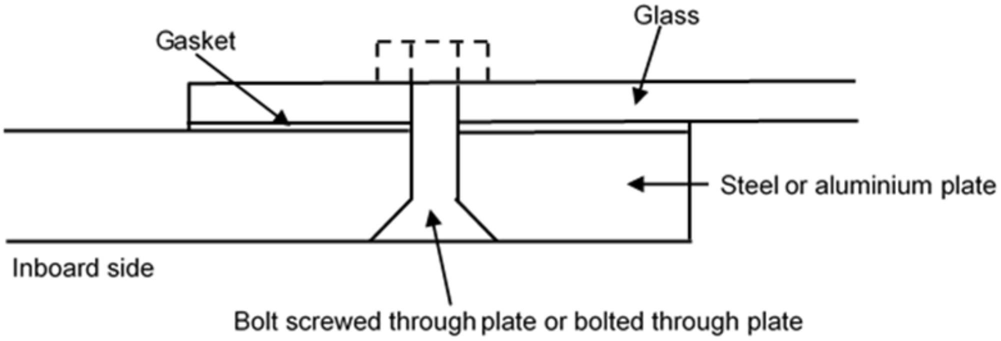

Figure 2.11.1 Bolt fixing

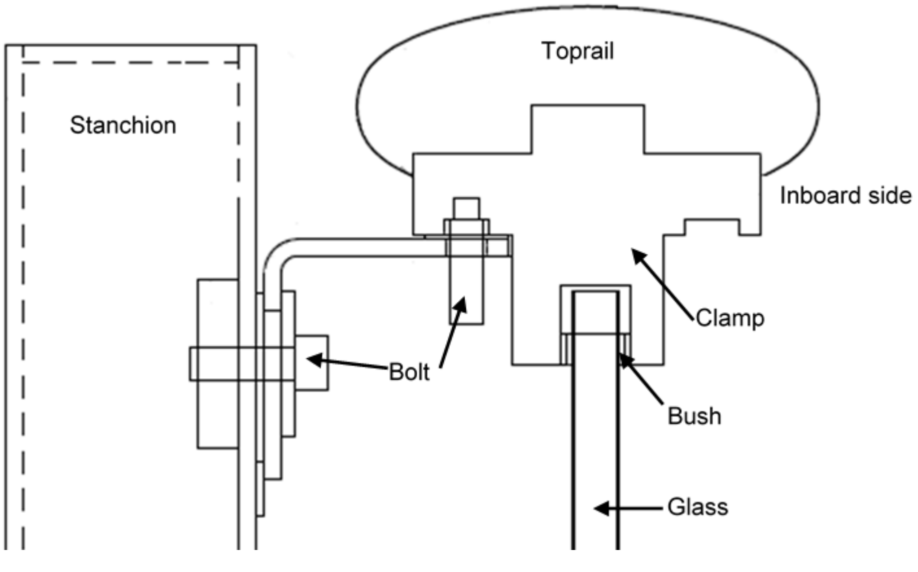

Figure 2.11.2 Clamp fixing

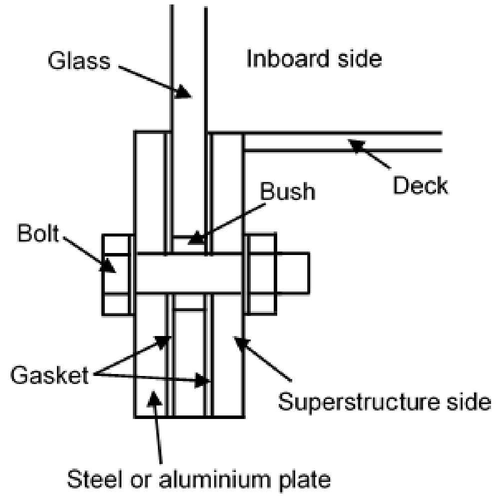

Figure 2.11.3 Continuous fixing clamp

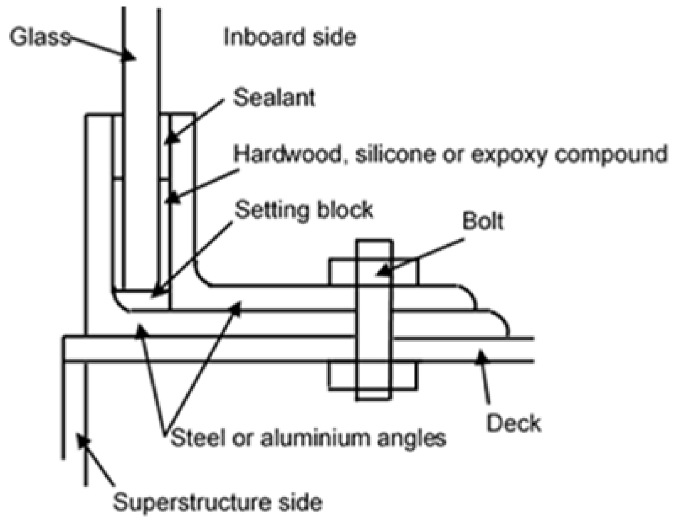

Figure 2.11.4 Alternative clamping system

11.9 Testing

11.9.1 External glass balustrades are to be subjected to a prototype pendulum test in accordance with EN 12600 *Glass in building – Pendulum test – Impact test method and classification for flat glass* or an equivalent recognised National or International Standard utilising a drop height of not less than 1,2 metres. The glass is not to fracture, no cracks are to form and the glass is to be retained in its frame/retaining arrangement.

11.9.2 Free-standing glass balustrades are to be assessed for post-failure strength where failure is to be induced in one glass ply and the impact test is to be repeated. The remaining glass ply or plies are not to fracture, no cracks are to form and the glass is to be retained in its frame/retaining arrangement.

11.9.3 Where it is proposed to use thermally strengthened glass, the failure mode of the glass balustrade is to be assessed where failure is to be induced in one of the plies. The glass is to fail in such a way that the glass fragments do not detach from the balustrade.

11.9.4 External glass balustrades (including both glass and retaining arrangement) are subject to a prototype strength test where the test pressure is taken as the design pressure multiplied by the safety factor, *see Pt 4, Ch 2, 11.4 Loads*. The glass is to be retained in its frame/retaining arrangement and the frame/retaining arrangement is not to detach from the deck.

■ *Section 17*
Enhanced fire safety arrangement

17.1 Goal

17.1.1 The purpose of this Section is to contain a fire in the space or area of origin and cool adjacent areas to prevent fire spread, structural damage and cargo loss on container ships.

17.1.2 Compliance with the requirements of the *International Convention for the Safety of Life at Sea 1974*, as amended, is requisite of this Section. The fire-fighting arrangements of this Section are supplementary to those given in SOLAS Chapter II-2.

17.2 General

17.2.1 Ships which comply with all the requirements of this Section will be assigned a notation **FIRE(C, WATER SPRAY)**. For ships which comply with all requirements of this Section except *Pt 4, Ch 8, 17.3 General 17.3.4* (i.e. ships which are not fitted with underdeck waterspray systems) will be assigned a notation of **FIRE(C)**.

17.2.2 The terms used in these requirements are as defined in the *International Convention for the Safety of Life at Sea 1974*, as amended (hereafter referred to as SOLAS).

17.2.3 The requirements of this Section are additional to those applicable in other Sections of this Chapter.

17.2.4 Special consideration, consistent with the fire hazard involved, will be given to construction or arrangement features not covered by this Section.

17.2.5 The plans and information are to be submitted as required in *Table 8.17.1 Documentation required for appraisal*, as applicable.

Table 8.17.1 Documentation required for appraisal

Document	For information	For appraisal
Fixed carbon dioxide fire-extinguishing system		×
Fixed waterspray system in cargo spaces		×
Fire control plan		×
Fire main piping arrangement		×

17.3 Fire-extinguishing arrangement for enclosed cargo spaces

17.3.1 Any openings that cannot be made gastight at the time of extinguishment shall be compensated for by the supply of additional quantities of CO_2 gas. The quantity of additional CO_2 gas required should be calculated based on guidelines developed by the IMO, e.g. MSC/Circ.1087.

17.3.2 Except for empty cargo hold conditions, advice shall be given that a suitable quantity of CO_2 gas, as recommended by the manufacturer, needs to be discharged on an intermittent basis to maintain fire suppression in the cargo space until the vessel reaches port or shore-side fire-fighting personnel arrive. The required quantity that needs to be discharged every time should be determined on the basis of the gap through which CO_2 gas is able to escape.

17.3.3 The closing devices fitted on ventilation openings of cargo spaces shall be easily accessible from the normal walkways and passageways, e.g. should be within reach for personnel standing on deck, and shall not be cut off by fire or hot gases produced within the space concerned.

If the closing devices are inaccessible from on deck (closing devices which require the use of a fixed/portable ladder to operate them are regarded as inaccessible), a suitable mechanism (e.g. wire ropes, or a handle, or other manual hydraulic handles) should be provided to allow operation from on deck.

17.3.4 A fixed waterspray system complying with *SOLAS Chapter II-2, Regulations 19.3.1.3 and 19.3.1.5*, for cooling and fire suppression, shall be installed for each underdeck cargo space.

The waterspray system piping and nozzle arrangement for each cargo hold shall be capable of being connected easily to fire mains by fire hoses of suitable size.

It is the responsibility of the Master to determine whether the system can be used for the cargoes being carried. It is understood that the water shall not be directly applied to materials that react with water, such as metallic sodium or calcium carbide, which produce violent reactions or increase hazardous products as a result of heated vapour emission.

17.4 Fire suppression arrangement for open decks

17.4.1 The water supply to the fire hydrants serving the cargo area shall be provided by a ring main supplied by the main fire pumps.

A single fire main may be provided as an alternative, supplied by fire pumps located fore and aft of the cargo area. The aggregate total capacity of fire pump(s) shall be of adequate capacity to supply the provided number of hydrants serving the required fire hoses, the water mist lances, the mobile water monitors and/or the waterspray system as applicable. The fire hydrants located at forward/afterward the damaged section of a single fire main system may be inaccessible based on the location of the accommodation where the crew members are living and working during normal operations are to be taken into consideration.

17.4.2 Stop valves shall be fitted in any crossover provided in the fire main or mains at sufficient intervals to ensure isolation of any damaged single section of the fire main. The distance between isolation valves shall not be greater than two (2) times the length of the fire hoses provided for use in the cargo area.

17.4.3 The fire main shall be provided with a sufficient number of fire hydrants on each side of the ship, to supply water for the required mobile water monitors and fire hoses.

17.4.4 Where the fire mains, as required in *Pt 4, Ch 8, 17.4 Fire suppression arrangement for open decks 17.4.1*, and isolation valves, as required in in *Pt 4, Ch 8, 17.4 Fire suppression arrangement for open decks 17.4.2*, are installed in underdeck enclosed spaces adjacent to the cargo spaces(e.g. passageways), which may be rendered inaccessible by a fire within the cargo area, then one means of following should be provided so that the required numbers of hydrants can be water supplied:

(a) the isolation valves within inaccessible spaces shall be capable of being operated from open deck and shall not be cut off by fire or hot gases;
(b) the isolation valves outside inaccessible spaces can be accessible and the required number of water jets from fire hoses and monitors can cover the cargo hold and deck above; or
(c) appropriate instructions for closing the isolation valves as mentioned in *Pt 4, Ch 8, 17.4 Fire suppression arrangement for open decks 17.4.4 (a)* within one hour from when the fire alarm was sounded.

17.4.5 For ships designed to carry fewer than five tiers of containers on or above the weather deck, at least two mobile water monitors complying with *MSC.1/Circ.1472* and at least one water mist lance shall be provided. The water mist lance shall consist of a tube with a piercing nozzle which is capable of penetrating a container wall and producing water mist inside a confined space (container, etc.) when connected to the fire main.

17.4.6 The horizontal throwing distance of the monitor, when it reaches the top tier of containers under the necessary pressure, shall be not less than the ship's breadth for ships with breadth less than 30 m, and not less than 30 m or half of the ship's breadth, whichever is greater, for ships with breadth of 30 m or more.

17.4.7 The mobile water monitors may be supplied by the fire main, provided the total capacity of fire pumps and the fire main diameter are adequate to simultaneously operate the mobile water monitors and two jets (four jets for ships which carry dangerous goods on deck in cargo areas) of water from fire hoses at the required pressure values.

If a fixed waterspray system is installed for each underdeck cargo space, for which water is supplied from the fire main, the total capacity of fire pumps and the fire main diameter should be adequate to simultaneously operate the system, the mobile water monitors and two jets (four jets for ships which carry dangerous goods on deck in cargo areas) of water from fire hoses at the required pressure values.

17.4.8 Fire hoses shall be provided of suitable size so as to ensure the required capacity of mobile water monitors, and of sufficient length, not less than 10 m, so as to ensure the safety of fire-fighters. The mobile water monitors, all necessary hoses, fittings and required fixing hardware shall be kept ready for use in a location outside the cargo space area not likely to be cut off in the event of a fire in the cargo spaces.

17.4.9 The mobile monitors shall be capable of being securely fixed to the ship's structure, ensuring safe and effective operation. The mobile monitors shall be capable of being rapidly and easily deployed on the uppermost level of lashing bridges. If the above is impracticable, the monitors having appropriate performance may be located other positions, e.g. at bridge top, and are able to provide effective water barriers forward and aft of each container bay.

17.5 Fire-fighter's outfits

17.5.1 In addition to those required by *SOLAS Chapter II-2, Regulation 10.10*, fire-fighter's outfits complying with the Fire Safety Systems Code shall be provided as per *Table 8.17.2 Minimum number of fire-fighter's outfits.*

Table 8.17.2 Minimum number of fire-fighter's outfits

Ship breadth (m)	Number of outfits	
	Local-operation monitors	Remote/unattended-operation monitors
≤ 30	10	6
> 30	14	6

17.5.2 At least one fully charged spare air bottle for each required breathing apparatus shall be provided.

17.5.3 An air compressor of adequate capacity, capable of continuous operation, suitable for the supply of high-pressure air of breathable quality, together with a charging manifold capable of simultaneously supplying all spare breathing apparatus air bottles, shall be provided.

17.5.4 A minimum of two two-way portable radiotelephone apparatus for every two sets of fire-fighter's outfits shall be provided. The two-way portable radiotelephone apparatus shall be of an explosion-proof type or intrinsically safe.

17.6 Fire detection devices for fire patrols on deck

17.6.1 Means are to be provided, which can be easily carried by the crew during fire patrols on board, to detect a potential fire in a container, so that the fire can be detected as early as possible, e.g. thermal imaging cameras. The equipment/devices are to be approved in accordance with a recognised standard.

17.7 Personnel safety

17.7.1 Suitable respiratory and eye protection for every person on board~~,~~ for emergency escape purposes, shall be provided to protect personnel from smoke and/or toxic gas produced by cargo fire.

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